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Health and Environmental Effects Profile for DCPA

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HEALTH AND ENVIRONMENTAL EFFECTS PROFILE FOR DCPA

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16. ABSTRACT

The Health and Environmental Effects Profile for DCPA was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human health, aquatic life and environmental effects of hazardous waste constituents.

Quantitative estimates have been presented provided sufficient data are available. DCPA has been determined to be a systemic toxicant. An Acceptable Daily Intake (ADI), defined as the amount of a chemical to which humans can be exposed on a daily basis over an extended period of time (usually a lifetime) without suffering a deleterious effect, for DCPA is 4.8×10^{-2} (mg/kg bw/day) for oral exposure.

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PREFACE

Health and Environmental Effects Profiles (HEEPs) are prepared for the Office of Solid Waste by the Office of Health and Environmental Assessment. The HEEPs are intended to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA). Both published literature and information obtained from Agency program office files are evaluated as they pertain to potential human health, aquatic life and environmental effects of hazardous waste constituents. The literature searched and the dates of the searches are included in the section titled "Appendix: Literature Searched."

Quantitative estimates are presented provided sufficient data are available. For systemic toxicants, these include, Acceptable Daily Intakes (ADIs) for chronic exposures. An ADI is defined as the amount of a chemical to which humans can be exposed on a daily basis over an extended period of time (usually a lifetime) without suffering a deleterious effect. In the case of suspected carcinogens, ADIs are not estimated in this document series. Instead, a carcinogenic potency factor or q_1^* is provided. These potency estimates are derived for both oral and inhalation exposures where possible. In addition, unit risk estimates for air and drinking water are presented based on inhalation and oral data, respectively.

The first draft of this document was prepared by Syracuse Research Corporation under EPA Contract No. 68-03-3228. The document was subsequently revised after reviews by staff within the Office of Health and Environmental Assessment: Carcinogen Assessment Group, Reproductive Effects Assessment Group, Exposure Assessment Group, and the Environmental Criteria and Assessment Office in Cincinnati.

The HEEPs will become part of the EPA RCRA docket.

ACKNOWLEDGEMENTS

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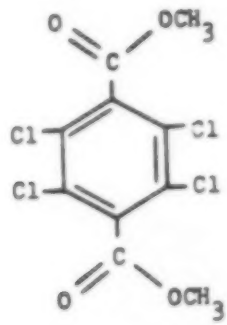
1. INTRODUCTION

1.1. STRUCTURE AND CAS NUMBER

DCPA is the common name for 2,3,5,6-tetrachloroterephthalic acid, dimethyl ester. Other chemical synonyms include dimethyl tetrachloroterephthalate, methyl 2,3,5,6-tetrachloro-1,4-benzenedicarboxylate, chlorthal and chlorthal-dimethyl. This herbicide was introduced in 1959 by the Diamond Shamrock Chemical Company under the code name "DAC 893" and the currently used trade name "Dacthal" (BCPC, 1977; WSSA, 1979). The structural and molecular formulae for DCPA are as follows:



Empirical formula: $C_{10}H_6Cl_4O_4$

Molecular weight: 332.0

The Chemical Abstracts Service (CAS) Registry number for DCPA is 1861-32-1.

1.2. PHYSICAL AND CHEMICAL PROPERTIES

DCPA is a white crystalline, essentially odorless compound. Selected physical and chemical properties are listed below (BCPC, 1977; WSSA, 1979):

Melting point:	156°C
Boiling point:	none; decomposes 360-370°C
Vapor pressure:	<0.01 mm Hg at 40°C

Solubility at 25°C:		
Solvent:	Acetone	100 g/kg
	Benzene	250 g/kg
	Dioxan	120 g/kg
	Carbon tetrachloride	70 g/kg
	Toluene	170 g/kg
	Xylene	140 g/kg
	Water	<0.5 mg/ℓ
	Water	0.5 ppm
Stability:	stable in the pure state and in w.p. formulations; non-corrosive; stable to decomposition by UV radiation	

1.3. PRODUCTION DATA

DCPA is produced by the chlorination of terephthalyl dichloride and reaction with methanol (BCPC, 1977) or by the esterification, with methanol, of tetrachloroterephthalic acid (Spencer, 1968).

The sole domestic producer of DCPA is the Diamond Shamrock Corp. in Greens Bayou, TX (SRI, 1983; USITC, 1983). Current production figures are not available. In 1975, domestic consumption of DCPA was 4.6 million pounds, with the capacity of the Diamond Shamrock manufacturing facility rated at 6 million pounds annually (SRI, 1976).

1.4. USE DATA

DCPA is used as a pre-emergence herbicide for the control of annual grasses and certain annual broadleaf species throughout the United States (WSSA, 1979; BCPC, 1977; Ouellette and King, 1977). It has applications for turf, ornamentals, and certain berries and vegetables. It is applied, generally, at planting time with a conventional sprayer delivering 25-40 gallons of water per acre; the amount of DCPA applied is 4-10 pounds per acre depending upon soil type and weed population.

2. ENVIRONMENTAL FATE AND TRANSPORT PROCESSES

2.1. WATER

Specific data regarding the fate or transport of DCPA in water were not located in the available literature. It is possible that the hydrolysis half-life is on the same order of magnitude as that of dimethyl terephthalate; the half-life for dimethyl terephthalate is 0.88 years at pH 7 and 25°C (Mabey and Mill, 1978). Due to the low solubility and low vapor pressure of DCPA, it is likely that the volatilization is insignificant and not on the same order of magnitude as the biodegradation rates discussed in Section 2.3.

As noted in Section 2.3., Chen et al. (1976) reported photolysis of DCPA from a glass surface. It is possible, therefore, that DCPA may undergo some photolysis in water, but this has not been investigated.

2.2. AIR

Specific data regarding the fate or transport of DCPA in air were not located in the available literature. DCPA is applied via spraying techniques; pesticide aerosols and vapors emitted from aerial spraying of crops can potentially be transported long distances by wind currents and can remain suspended in air for long time periods, become sorbed on airborne particles and undergo photochemical alterations (Lee, 1977). The probability of chemical or photochemical reactions of DCPA in the atmosphere has not been investigated.

2.3. SOIL

WSSA (1979) reports the following DCPA behavior in or on soils: adsorbed by organic matter in soil and does not leach in any of the soil types; microbes and chemical hydrolysis are the primary factors in the disappearance of DCPA from the soil; no loss from photodecomposition or

volatilization in practical use; the average half-life is 100 days in most general soil types.

Leaching is not considered important in the movement of DCPA in soil (Miller et al., 1978). Miller et al. (1978) applied DCPA at two rates (9.0 and 17.9 kg/ha) to Panoche loam for 6 years as soil-incorporated broadcast sprays directed to the base of cotton at last cultivation. Chemical determinations 6 months after annual treatment showed that DCPA residues were essentially confined to the tilled zone of soil; 1 year after final treatment, DCPA residues below the tilled zone were not detectable. Residues did not accumulate in the tilled zone (upper 30 cm) when six annual applications were made to the same soil; DCPA residues were relatively high during the first three applications, but were lower for the fourth, fifth and sixth applications. Miller et al. (1978) suggested that the lower rates were due to an increase in microflora, which metabolized DCPA as applications were repeated. Bryant and Andrews (1967) applied DCPA in the field to clay loam and silt loam soils for up to 3 years; at the highest rates of application, DCPA remained in the top 0-5 inches of soil. An abstract of a Russian study reports that levels of DCPA were not found any deeper than 20 cm in soil 10-120 days after treatment (Parshutin et al., 1979). Helling et al. (1971) have reported that DCPA is very strongly adsorbed in soil and have classified DCPA as immobile in soil.

The available literature indicates that plant uptake of DCPA is very small. Iyer et al. (1969) measured the uptake in white pine and Monterey pine from a sandy soil and fallow cultures of the same soil. Analysis of ^{14}C-labeled extracts from the pine tissue showed that uptake of DCPA varied from 0.25-1.2% of the total amount of DCPA added to the soil. Very limited mobility of DCPA in the plant was observed and the concentration in

the shoots was <10 ppm. About 80% of the DCPA absorbed remained in the root systems; plant growth led to a rapid dilution of absorbed DCPA. Iyer et al. (1969) noted that the soil used for their cultures likely contained a much smaller capacity for adsorbing DCPA than would be encountered normally; therefore, DCPA uptake in the environment would probably be much smaller than the values they determined. In an abstract of a Russian study, it was reported that DCPA was found to accumulate gradually in onion leaves for up to 60 days; after 3 months, it was found only in the onion bulbs (Parshutin et al., 1979).

Chen et al. (1976) have studied the photodecomposition of DCPA on glass. A thin film of DCPA on a glass surface was exposed to sunlight or UV irradiation. After 2 hours of exposure, monomethyl tetrachloroterephthalate and tetrachloroterephthalic acid were found, whereas 1,2,4,5-tetrachlorobenzene was found after 4 hours. This may indicate that DCPA can undergo photolysis from the surface of soils to which it is applied.

DCPA undergoes microbial degradation in soils (Bone, 1970; Tweedy et al., 1968; WSSA, 1979). Tweedy and Turner (1965) determined that several species of fungi, bacteria and actinomycetes are able to metabolize DCPA and several of these microorganisms can use the herbicide as a sole carbon source. Tweedy et al. (1968) reported that DCPA degradation occurs intracellularly by microorganisms.

The effects of DCPA were evaluated on selected soil bacteria, fungi and actinomycetes in pure cultures and on their total numbers under field conditions (Bone, 1970). It was demonstrated with sterile (autoclaved) soil that DCPA levels remained constant after 4 weeks, whereas DCPA disappeared rapidly in soils under conditions conducive to high microbial activity (favorable moisture, temperature and soil type). There appeared to be a lag

phase of ~2 weeks before DCPA degradation began in soil, possibly allowing the development of a specialized microbial population with the ability to metabolize DCPA.

The degradation rate of DCPA in various soil types and under varying conditions has been studied by a number of investigators. Roberts et al. (1978) studied DCPA persistence in six experiments on sandy loam soil at different times of the year. When applied in May, the half-life was ~100 days; when applied in October, 55% was still present in the following April. Walker (1978), in a study on sandy loam soil in the field, determined the following persistence of DCPA as applied in May, 1977: 70 days, 70% remaining; 80 days, 60% remaining; 120 days, 45% remaining. In laboratory cultures of sandy soil and fallow, Iyer et al. (1969) observed that in 120 days, 55-63% of the added DCPA had been lost. Hurto et al. (1979), in laboratory experiments, found that DCPA degraded faster in thatch than in Kentucky bluegrass soil; in the soil, ~65% of the DCPA remained after 100 days, while in the thatch, ~20% remained after 100 days.

The degradation rate of DCPA is affected by soil type and composition, temperature and moisture. Bone (1970) reported twice as much metabolism of DCPA in muck soil than in silt loam, while Hurto et al. (1979) found greater metabolism in thatch than in the soil. According to Hurto et al. (1979), this presumably reflects higher microbial activity associated with an organic medium. Walker (1978) studied the half-life of DCPA in soil as a function of temperature and moisture content in the laboratory. With similar moisture content, the half-life of DCPA becomes shorter with increasing temperatures (from 5-30°C); at 5°C (9.1% moisture) the half-life was 295 days, while at 15°C (9.2% moisture) the half-life was 90.1 days and at 25°C (9.2% moisture) the half-life was 24.5 days. Similarly, as moisture

content increased and temperature remained constant, the half-life became shorter; at moisture content of 2.7% (20°C) the half-life was 197 days, at 5.6% moisture (20°C) the half-life was 79.6 days and at 12.2% moisture (20°C), the half-life was 40.5 days. Chen et al. (1976) reported that DCPA was degraded in flooded soils within 20 days, but persisted in air-dry soils.

Gorshon and McClure (1966) have reported that degradation of DCPA occurs by successive dealkylations of the two methyl groups at the ester linkages with the formation of monomethyl tetrachloroterephthalate and tetrachloroterephthalic acid. The studies of Hurto et al. (1979) seem to confirm that these are two metabolites of DCPA occurring in soil degradation. Chen et al. (1976) found, in addition to the above metabolites, 1,2,4,5-tetrachlorobenzene in photolysis products from a glass surface.

3. EXPOSURE

3.1. WATER

DCPA has been detected in river water and in five species of fish in the lower Rio Grande Valley of Texas (Miller and Gomes, 1974). Analyses of unfiltered water samples taken over a 2-year period indicated that DCPA concentrations were usually <1 ppb, although the highest single concentration recorded was 132 ppb. The water samples were analyzed without removing the particulate matter and the authors noted that it was not known if the DCPA residues were in the water or in association with suspended particles. Residues in one freshwater and four saltwater fish species varied from <1 ppb to 8 ppm.

Sheldon and Hites (1979) have detected DCPA in Delaware River water, which leads into the drinking water supply of Philadelphia, PA. Samples were collected in August, 1977, and levels of DCPA were identified as undetectable to 0.03 ppb. The authors indicated that it was believed that the DCPA entered the river water via rainwater runoff.

Maddy et al. (1982) monitored well water from 54 sources in California and found no detectable levels of DCPA. Trace levels of DCPA have been found in various water samples taken from the Kitakyushu area of Japan (Akiyama et al., 1980).

The mean concentration of DCPA in 1216 samples of whole water was reported in STORET to be 0.13 µg/ℓ (range 0-30 µg/ℓ). Printouts of the reporting stations indicate that this mean reflects detection of high levels of DCPA in stream water in several locations and does not imply widespread occurrence of detectable DCPA in ambient water; it appears the DCPA was not detectable in most of the samples.

3.2. FOOD

The Food and Drug Administration (FDA), U.S. Department of Health and Human Services (formerly Health, Education, and Welfare) has been monitoring the United States' total diet in a program (sometimes called the Market Basket study) that has been surveying food for residues of many pesticides; DCPA residues have been found in various food samples during this program (Corneliussen, 1970, 1972; Manske and Corneliussen, 1974; Johnson and Manske, 1976, 1977; Manske and Johnson, 1977; Johnson et al., 1981a). The Total Diet Study collected ready-to-eat foods (in the average diet of the young adult male) from 20-30 cities nationwide having populations ranging from <50,000-1,000,000 or more. The collected food composites were then analyzed, by food classes, for pesticide residues. The results of the analyses, with respect to DCPA, are summarized in Table 3-1. In general, the DCPA residues were found in the food classes identified as leafy and root vegetables and garden fruits; this is not surprising, as DCPA is a common herbicide used in onion fields. In August 1974, the Total Diet Program began analyzing infant and toddler diet samples; no traces of DCPA were detected in 120 food composite samples during August 1975 to July 1976 (Johnson et al., 1981b).

3.3. INHALATION

Tessari and Spencer (1971) monitored air samples for various pesticides at the homes of 12 occupationally (five farmers and seven formulator-applicators) exposed men for 1 year. These were families in which the head of the household worked directly with pesticide chemicals in one way or another. The pesticides in the air were collected on test screens; the results with respect to DCPA are summarized in Table 3-2. Air concentrations in terms of mass per air volume were not determined.

TABLE 3-1

DCPA Residues Found in Food Composites in the Total Diet Program*

Reporting Period	Total No. of Composites Analyzed	No. of Composites with with Residues	No. of Composites with DCPA Trace Amounts	DCPA Residue Ranges (ppm)
August 1975-July 1976	240	5	1	0.002-0.014
August 1974-July 1975	240	1	0	0.003
August 1973-July 1974	360	2	0	0.003-0.013
August 1972-July 1973	360	1	0	0.013
June 1970-April 1971	360	1	1	trace
June 1969-April 1970	360	1	0	0.088
June 1968-April 1969	360	6	5	0.032

*Sources: Cornelíussen, 1970, 1972; Manske and Cornelíussen, 1974; Johnson and Manske, 1976, 1977; Manske and Johnson, 1977; Johnson et al., 1981a

TABLE 3-2

Summary of DCPA Residues Collected from Test Screens of Occupationally Exposed Workers[a]

Statistic[b]	Farmers		Formulators	
	Inuoor Air (µg/mi²)	Outdoor Air (µg/mi²)	Indoor Air (µg/mi²)	Outdoor Air (µg/mi²)
N	38	37	52	54
F	31	31	48	39
NX	2.32	1.03	0.97	1.22
FX	2.84	1.23	1.05	1.68
Range	0.08-12.04	0.02-9.12	0.05-8.72	0.08-38.26

[a]Source: Tessari and Spencer, 1971

[b]N = Number of samples taken
F = Frequency of DCPA found out of N
NX = Numerical mean (sample mean)
FX = Frequency mean

Lee (1977) has reported airborne concentrations of DCPA; air samples were collected at selected sites in 14 states in 1970 and in 16 states in 1971 and 1972. Thirty-two different pesticides were identified. DCPA was identified in 0.49% of the samples taken, with an arithmetic mean concentration of a trace, a mean concentration of 1.0 ng/m³ in the positive samples and a maximum concentration of 2.1 ng/m³.

Air residues of DCPA were found during the first part of the vegetable-growing season in weekly monitoring of the lower Rio Grande Valley during September to December 1972 (Miller and Gomes, 1974). The mean air sample value for the 4-month period was 1.94 µg/m³ with ranges of 0.90-8.62 µg/m³. Higher levels were found in samples near a vegetable-growing area; there, the mean level was 4.73 µg/m³.

DCPA has been identified in concentrations ranging from 1.53-59.71 ppm in household dust collected in Weld County, CO (Starr et al., 1974). DCPA was found in the farmers', formulators' and control group's house-dust residues.

3.4. DERMAL

Pertinent data regarding the levels of DCPA on skin were not located in the available literature cited in the Appendix. (see Appendix for literature searched; also additional classified information is available. See Chapter 8 for a more complete explanation.)

4. PHARMACOKINETICS

4.1. ABSORPTION

Metabolism and urinary excretion data indicate that DCPA is absorbed from the gastrointestinal tract of cows (Sections 4.3. and 4.4.) (Gutenmann and Lisk, 1966). Further details regarding the actual levels of DCPA observed in blood plasma or the kinetics of absorption were not found in the available literature cited in the Appendix.

4.2. DISTRIBUTION

Pertinent data regarding the distribution of DCPA were not located in the available literature cited in the Appendix.

4.3. METABOLISM

Gutenmann and Lisk (1966) examined the metabolism of DCPA in lactating cows given diets containing 5 ppm of the compound for 4 days. DCPA was hydrolyzed to the monoacid, monomethyl-tetrachloroterephthalate (detected by GC analysis), which was excreted in the urine and feces of treated cows at levels of 90.9 and 3.3% of the administered dose (based on mg totals), respectively, within 9 days after the initial treatment. The monoacid was not detected in the milk of treated animals during the 4-day treatment period or during the 5-day period following treatment. Over the 9-day period, 1% of the administered DCPA was excreted intact in the feces. DCPA was not decomposed by rumen contents when incubated *in vitro* for 6 hours, but rapid hydrolysis (within 30 minutes) to the same *in vivo* monoacid metabolite occurred when DCPA was incubated *in vitro* with beef liver slices (Gutenmann and Lisk, 1966).

4.4. EXCRETION

Gutenmann and Lisk (1966) recovered 0, 3.3 and 90.9% of the administered DCPA (based on mg totals), given at a level of 5 ppm in the diet to lactat-

ing cows for 4 days, as the monoacid metabolite in milk, feces and urine, respectively, within 9 days after the initial treatment (see Section 4.3.). Treated cows excreted 1% of the ingested DCPA as intact compound over the 9-day period. (See Appendix for literature searched; also additional classified information is available. See Chapter 8 for a more complete explanation.)

5. EFFECTS

5.1. CARCINOGENICITY

Pertinent data regarding the carcinogenicity of DCPA were not located in the available literature cited in the Appendix. This compound is not scheduled for testing by the National Toxicology Program (NTP, 1983).

5.2. MUTAGENICITY

DCPA has been tested for genotoxicity in several prokaryotic and eukaryotic systems. These assays are summarized in Table 5-1.

DCPA was negative in the reverse mutation assay with Salmonella typhimurium, regardless of the absence or presence of mammalian or plant (corn or wheat) metabolic activation systems (Andersen et al., 1972; Moriya et al., 1983; Wildeman and Nazar, 1982). When both mammalian and plant (corn or wheat) metabolic activation were present, however, positive results were obtained for strain TA100 (Wildeman and Nazar, 1982). DCPA was negative in both the reverse mutation assay with Escherichia coli (Moriya et al., 1983) and the rec-assay with Bacillus subtilis (Shirasu et al., 1976).

Exposure of Drosophila melanogaster to DCPA via larval feeding did not result in a significant increase in sex-linked recessive lethal mutations (Paradi and Lovenyak, 1981). Treatment of mouse bone marrow cells with DCPA resulted in an increased number of aberrations/aberrant metaphase, but not an increase in the total number of aberrant metaphases (Kurinnyi et al., 1982).

5.3. TERATOGENICITY

Shepel'skaya (1981) observed increased pre- and post-implantation fetal deaths after administering DCPA orally to rats at levels of 0.12 and 10 mg/kg/day during gestation. Neither fetal body weight (bw) nor offspring survival were affected by treatment. This Russian study was available only as an abstract, and, therefore, further details were not reported.

TABLE 5-1

Genotoxicity Testing of DCPA

Assay	Indicator Organism	Application	Concentration or Dose	Activation System	Response	Reference
Reverse mutation	Salmonella typhimurium 8 histidine-deficient strains, NOS	spot test	~1-5 µl	none	-	Andersen et al., 1972
Reverse mutation	S. typhimurium TA98 TA100 TA1535 TA1537 TA1538	plate incorporation	<5000 µg/plate	±S-9	 = = = = =	Moriya et al., 1983
Reverse mutation	S. typhimurium TA98 TA100	plate incorporation	500 µg/plate	±S-9	 = =	Wildeman and Nazar, 1982
Reverse mutation	S. typhimurium TA98 TA100	plate incorporation	500 µg/plate	±S-14 (corn or wheat)	 = =	Wildeman and Nazar, 1982
Reverse mutation	S. typhimurium TA98 TA100	plate incorporation	500 µg/plate	±S-9, +S-14 (corn or wheat)	 - +	Wildeman and Nazar, 1982
Reverse mutation	Escherichia coli WP2 hcr	plate incorporation	<5000 µg/plate	±S-9	=	Moriya et al., 1983

TABLE 5-1 (cont.)

Assay	Indicator Organism	Application	Concentration or Dose	Activation System	Response	Reference
Rec-assay	Bacillus subtilis H17 Rec+ M45 Rec-	spot test	NR	none	 - -	Shirasu et al., 1976
Sex-linked recessive lethal	Drosophila melanogaster	larval feeding	NR	none	-	Paradi and Lovenyak, 1981
Chromosome aberrations	mouse bone marrow	cell culture	NR	NR	"+"*	Kurinnyi et al., 1982

*Treatment with DCPA resulted in an increased number of aberrations/aberrant metaphase, but not an increase in the total number of aberrant metaphases.

NR = Not reported

NOS = Not otherwise specified

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5.4. OTHER REPRODUCTIVE EFFECTS

Shepel'skaya (1981) reported gonadotoxic effects in rats given DCPA orally at a level of 0.12 or 10 mg/kg/day for 10 weeks. These gonadotoxic effects included prolonged estrus phase, reduced spermatozoid mobility and unspecified disrupted reproduction. There was no dose-effect relationship. This Russian study was available only as an abstract and, therefore, further details were not reported.

5.5. CHRONIC AND SUBCHRONIC TOXICITY

Pertinent data regarding the chronic or subchronic toxicity of DCPA were not located in the available literature cited in the Appendix.

5.6. OTHER RELEVANT INFORMATION

The oral median lethal dose (LD_{50}s) of DCPA for rats has been reported to be 3000 mg/kg (NIOSH, 1983). An intravenous LD_{50} of 320 mg/kg for mice and a dermal LD_{50} of 10 g/kg for rabbits have been reported (NIOSH, 1983).

Bach and Pedersen (1980) reported the case study of a 55-year-old cabinet maker with contact dermatitis (hands and face) from occupational exposure to wood preservatives containing 0.5% DCPA. A patch test with 0.01% DCPA in acetone gave a positive reaction. Patch tests with control subjects resulted in toxic skin reactions in both of 2 control persons exposed to 1% DCPA in acetone, 2 of 10 control persons exposed to 0.1% DCPA in acetone, and 0 of 10 control persons exposed to 0.01% DCPA in acetone. The possibility of sensitive humans occupationally exposed to DCPA developing contact dermatitis is confounded by the persistence of this compound on the hands of exposed workers, which has been reported to range from 1-112 days (Kazen et al., 1974). (See Appendix for literature searched; also additional classified information is available. See Chapter 8 for a more complete explanation.)

6. AQUATIC TOXICITY

6.1. ACUTE

The only information regarding the acute toxicity of DCPA to aquatic animals was provided by Schneider (1979). The 96-hour LC_{50} of a 75% wettable powder formulation was 30.0 ppm to rainbow trout, Salmo gairdneri. Exposure for 96 hours to as much as 320 ppm of the same formulation was not lethal to bluegills, Lepomis macrochirus. Waterfleas, Daphnia magna, were intermediate in sensitivity, as shown by a 48-hour LC_{50} of 138.0 ppm.

6.2. CHRONIC

Pertinent data regarding the chronic toxicity of DCPA to aquatic animals were not located in the available literature cited in the Appendix.

6.3. PLANT EFFECTS

Vance and Smith (1969) reported that DCPA concentrations as high as 200 ppm had no toxic effects on three species of aquatic algae, Scenedesmus quadricauda, Chlamydomonas eugametos, Chlorella pyrenoidosa.

6.4. RESIDUE

Pertinent data regarding residues of DCPA in aquatic organisms were not located in the available literature cited in the Appendix.

6.5. OTHER RELEVANT INFORMATION

Other relevant information regarding DCPA in the aquatic environment was not located in the available literature cited in the Appendix. (See Appendix for literature searched; also additional classified information is available. See Chapter 8 for more complete explanation.)

7. EXISTING GUIDELINES AND STANDARDS

7.1. HUMAN

The U.S. EPA has established tolerances for the residues of DCPA and its metabolites, monomethyl tetrachloroterephthalate and tetrachloroterephthalic acid, in or on raw agricultural produce (Code of Federal Regulations, 1979). In defining these tolerances, the levels of metabolites are expressed as levels of DCPA. The established tolerances range from 0.05 ppm for corn (sweet, pop and grain) to 0.4 ppm for other corn products (fodder and forage), and 1-5 ppm for a variety of vegetables.

7.2. AQUATIC

Existing guidelines and standards for DCPA in the aquatic environment were not located in the available literature cited in the Appendix.

8. RISK ASSESSMENT

No carcinogenicity assays of DCPA were available. DCPA was negative in several bacterial genotoxicity assays and in the sex-linked recessive lethal assay with Drosophila melanogaster (Andersen et al., 1972; Moriya et al., 1983; Wildeman and Nazar, 1982; Shirasu et al., 1976; Paradi and Lovenyak, 1981). An increased number of aberrations/aberrant metaphase, but no increase in the total number of aberrant metaphases, was observed in mouse bone marrow cells incubated with DCPA (Kurinnyi et al., 1982). Shepel'skaya (1981) reported increased pre- and postimplantation deaths and gonadotoxic effects in rats given DCPA orally at a level of 0.12 or 10 mg/kg bw/day.

The lack of any adequate carcinogenicity assays and chronic or subchronic toxicity studies in the available published literature precluded the derivation of a quantitative criterion for DCPA.

Statements concerning available literature in this document refer to published, quotable sources and are in no way meant to imply that confidential data, which this document could not address, are not in existence. These data, which are considered Confidential Business Information (CBI), are available in summary form as a CBI Appendix that can be accessed by individuals with appropriate clearance. Conclusions from the CBI Appendix regarding risk assessment can, however, be presented in this chapter.

The CBI Appendix to this document reviews other animal data from which an ADI of 0.0483 mg/kg bw/day, or 3.38 mg/day for a 70 kg man, was derived.

The ADI was based on a NOAEL of 4.83 mg/kg bw/day in female rats in a 2-year feeding study using an uncertainty factor of 100 (10 to account for interspecies extrapolation and 10 for protection of the most sensitive individuals within the human population). A single dose of 36.1 mg/kg bw administered to male rats resulted in statistically significant preimplantation losses in a dominant lethal assay; repeated dietary exposure at 75 mg/kg bw/day resulted in a reduced lactation index in a reproduction study using rats.

9. REFERENCES

Akiyama, T., M. Koga, R. Shinohara, A. Kido and S. Etoh. 1980. Detection and identification of trace organic substances in the aquatic environment. J. UOEH. 2(3): 285-300. (CA 94: 108875u)

Andersen, K.J., E.G. Leighty and M.T. Takahashi. 1972. Evaluation of herbicides for possible mutagenic properties. J. Agric. Food Chem. 20: 649-656.

Bach, B. and N.B. Pedersen. 1980. Contact dermatitis from a wood preservative containing tetrachloroisophthalonitrile. Contact Dermatitis. 6(2): 142.

BCPC (British Crop Protection Council). 1977. Chlorthal-Dimethyl. In: Pesticide Manual, 5th ed., Martin, H. and C.R. Worthing, Ed. BCPC Publications, Worcestershire, England. p. 120.

Bone, H.T. 1970. Breakdown of dimethyl 2,3,5,6-tetrachloroterephthalate (DCPA) in soil and its effect on certain processes of soil microorganisms. Diss. Abstr. Int. B 1970. 31(1): 17. Available from Univ. Microfilms, Ann Arbor, MI, Order No. 70-8269.

Bryant, T.A. and H. Andrews. 1967. Disappearance of diruon, norea, linuron, trifluralin, diphenamid, DCPA and prometryne from the soil. Proc. South. Weed Conf. 20: 395-404. (CA 67: 42814g)

Chen, Y., C. Fang, L. Chen and Y. Wang. 1976. Photodecomposition and behavior of herbicides benthiocarb and DCPA in soils. Chung-Kuo Nung Yeh Hua Hsueh Hui Chih. 14(1-2): 59-67. (CA 86: 84609s)

Code of Federal Regulations. 1979. Dimethyl tetrachloroterephthalate; tolerances for residues. 40 CFR 180.185.

Corneliussen, P.E. 1970. Pesticide residues in total diet samples (V). Pestic. Monit. J. 4(3): 89-105.

Corneliussen, P.E. 1972. Pesticide residues in total diet samples (VI). Pestic. Monit. J. 5(4): 313-330.

Gershon, H. and G.W. McClure, Jr. 1966. Approach to the study of the degradation of dimethyl tetrachloroterephthalate. Contrib. Boyce Thompson Inst. 23: 291-294. (CA 66: 64585q)

Gutenmann, W.H. and D.J. Lisk. 1966. Metabolism of Daconil and Dacthal pesticides in lactating cows. J. Dairy Sci. 49(10): 1272-1276.

Helling, C.S., P.C. Kearney and M. Alexander. 1971. Behavior of pesticides in soils. Adv. Agr. 23: 147-240.

Hurto, K.A., A.J. Turgeon and M.A. Cole. 1979. Degradation of benefin and DCPA in thatch and soil from a Kentucky bluegrass (Poa pratensis) turf. Weed Sci. 27(2): 154-157.

Iyer, J.G., G. Chesters and S.A. Wilde. 1969. Chlorthal degradation in soils and its uptake by pine seedlings. Weed Res. 9: 53-61.

Johnson, R.D. and D.D. Manske. 1976. Pesticide residues in total diet samples (IX). Pestic. Monit. J. 9(4): 157-169.

Johnson, R.D. and D.D. Manske. 1977. Pesticide and other chemical residues in total diet samples (XI). Pestic. Monit. J. 11(3): 116-131.

Johnson, R.D., D.D. Manske and D.S. Podrebarac. 1981a. Pesticide, metal, and other chemical residues in adult total diet samples (XII). August 1975-July 1976. Pestic. Monit. J. 15(1): 54-69.

Johnson, R.D., D.D. Manske, H.N. Hall and D.S. Podrebarac. 1981b. Pesticide, heavy metal, and other chemical residues in infant and toddler total diet samples (II). August 1975-July 1976. Pestic. Monit. J. 15(1): 39-50.

Kazen, C., A. Bloomer, R. Welch, A. Oudbier and H. Price. 1974. Persistence of pesticides on the hands of some occupationally exposed people. Arch. Environ. Health. 29(6): 315-318.

Kurinnyi, A.I., M.A. Pilinskaya, I.V. German and T.S. L'Vova. 1982. Realization of the pesticide cytogenetic study program: Primary estimation of cytogenetic activity and potential mutagenic hazards of 24 pesticides. Tsitol. Genet. 16(1): 45-49. (Rus.) (CA 96: 156990r)

Lee, R.E., Jr. 1977. Air pollution from pesticides: A critical assessment. In: Proc. Int. Clean Air Congr., 4th., Kasuga, S., et al., Ed. U.S. EPA, Health Effects Lab., Research Triangle Park, NC. p. 37-40.

Mabey, W. and T. Mill. 1978. Critical review of hydrolysis of organic compounds in water under environmental conditions. J. Phys. Chem. Ref. Data. 7(2): 383-415.

Maddy, K.T., H.R. Fong, J.A. Lowe, D.W. Conrad and A.S. Fredrickson. 1982. A study of well water in selected California communities for residues of 1,3-dichloropropene, chloroallyl alcohol and 49 organophosphate or chlorinated hydrocarbon pesticides. Bull. Environ. Contam. Toxicol. 29: 354-359.

Manske, D.D. and P.E. Corneliussen. 1974. Pesticide residues in total diet samples (VII). Pestic. Monit. J. 8(2): 110-124.

Manske, D.D. and R.D. Johnson. 1977. Pesticide and other chemical residues in total diet samples (X). Pestic. Monit. J. 10(4): 131-166.

Miller, F.M. and E.d. Gomes. 1974. Detection of DCPA residues in environmental samples. Pestic. Monit. J. 8(1): 53-58.

Miller, J.H., P.E. Keeley, R.J. Thullen and C.H. Carter. 1978. Persistence and movement of ten herbicides in soil. Weed Sci. 26(1): 20-27.

Moriya, M., T. Ohta, K. Watanabe, T. Miyazawa, K. Kato and Y. Shirasu. 1983. Further mutagenicity studies on pesticides in bacterial reversion assay systems. Mutat. Res. 116(3-4): 185-216.

NIOSH (National Institute for Occupational Safety and Health). 1983. RTECS (Registry of Toxic Effects of Chemical Substances). November, 1983: online.

NTP (National Toxicology Program). 1983. Chemicals on Standard Protocol: Management Status. Report dated 6/15/83.

Ouellette, R.P. and J.A. King. 1977. Chemical Week Pesticides Register. McGraw-Hill, Inc., NY. p. 172.

Paradi, E. and M. Lovenyak. 1981. Studies on genetical effect of pesticides in Drosophila melanogaster. Acta. Biol. Acad. Sci. Hung. 32(2): 119-122.

Parshutin, S.M., T.V. Khripko, I.T. Zabaluyer and M.R. Rakhmanov. 1979. Dacthal and alicep residues in soil and in onion plants. Khim. Sel'sk. Khoz. 17(4): 47-49. (Taken from PESTAB/79/2629).

Pimentel, D. 1971. Ecological effects of pesticides on non-target species. U.S. EPA, Washington, DC. Available from NTIS PB 269605.

Roberts, H.A., A. Walker and W. Bond. 1978. Persistence of chlorthaldimethyl activity in soil. Proc. Br. Crop Prot. Conf.-Weeds. 14(1): 87-92. (CA 91: 131lt)

Schneider, B.A. 1979. Toxicology Handbook. Mammalian and Aquatic Data. Book 1. Toxicology Data. EPA-540/9-79-003A. U.S. EPA, Washington, DC. Available from NTIS PB 80-196876.

Sheldon, L.S. and R.A. Hites. 1979. Sources and movement of organic chemicals in the Delaware River. Environ. Sci. Technol. 13(5): 574-579.

Shepel'skaya, N.R. 1981. Effect of the herbicide Dacthal on animal gonads. Gig. Sanit. 8: 22-24. (Rus.) (CA 95: 163449d)

Shirasu, Y., M. Moriya, K. Kato, A. Furuhashi and T. Kada. 1976. Mutagenicity screening of pesticides in the microbial system. Mutat. Res. 40: 19-30.

Spencer, E.Y. 1968. Guide to the Chemicals Used in Crop Protection, 5th ed. Publ. 1093, Canada Department of Agriculture. p. 208.

SRI (Stanford Research Institute). 1976. Herbicides. In: Chemical Economics Handbook. Stanford Research Institute, Menlo Park, CA. p. 573.7002U, 573.7008G-H.

SRI (Stanford Research Irstitute). 1983. 1983 Directory of Chemical Producers: U.S.A. SRI International, Menlo Park, CA. p. 778.

Starr, H.G., Jr., F.D. Aldrich, W.D. McDougall, Jr. and L.M. Mounce. 1974. Contribution of household dust to the human exposure to pesticides. Pestic. Monit. J. 8(3): 209-212.

Tessari, J.D. and D.L. Spencer. 1971. Air sampling for pesticides in the human environment. J. Assoc. Offic. Anal. Chem. 54(6): 1376-1382.

Tweedy, B.G. and N. Turner. 1965. Effect of Dacthal on soil microorganisms. Phytopathology. 55: 1080.

Tweedy, B.G., N. Turner and M. Achituv. 1968. The interactions of soil-borne microorganisms and DCPA. Weed Sci. 16: 470-473.

USITC (United Stated International Trade Commission). 1983. Synthetic Organic Chemicals. U.S. Production and Sales, 1982. USITC Publ. 1422. p. 228.

Vance, B.D. and D.L. Smith. 1969. Effects of five herbicides on three green algae. Toxicol. J. Sci. 20: 329-337. (Cited in Pimentel, 1971)

Walker, A. 1978. Simulation of the persistence of eight soil-applied herbicides. Weed Res. 18(5): 305-313.

Wildeman, A.G. and R.N. Nazar. 1982. Significance of plant metabolism in the mutagenicity and toxicity of pesticides. Can. J. Genet. Cytol. 24(4): 437-449.

WSSA (Weed Science Society of America). 1979. DCPA. In: Herbicide Handbook of the Weed Science Society of America, 4th ed. WSSA, Champaign, IL. p. 141-143.

APPENDIX

LITERATURE SEARCHED

This profile is based on data identified by computerized literature searches of:

CA SEARCH (Files 308, 309, 310, 311, 320)
TOXLINE
MEDLINE
RTECS
SCI SEARCH
OHM TADS
STORET
SRC Environmental Fate Data Bases
SANSS
AQUIRE

These searches were conducted in November, 1983. In addition, hand searches were made of Chemical Abstracts (Collective Indices 6 and 7th), and the following secondary sources were reviewed:

ACGIH (American Conference of Governmental Industrial Hygienists). 1980. Documentation of the Threshold Limit Values, 4th ed. (Includes Supplemental Documentation, 1981, 1982, 1983). Cincinnati, OH. p. 486.

ACGIH (American Conference of Governmental Industrial Hygienists). 1983. TLVs: Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes for 1983-1984. Cincinnati, OH. p. 94.

BCPC (British Crop Protection Council). 1977. Pesticide Manual, 5th ed., H. Martin and C.R. Worthing, Ed. British Crop Protection Council. p. 593.

Clayton, G.D. and F.E. Clayton, Ed. 1981. Patty's Industrial Hygiene and Toxicology, 3rd rev. ed., Vol. 2A. John Wiley and Sons, NY. p. 2878.

Clayton, G.D. and F.E. Clayton, Ed. 1981. Patty's Industrial Hygiene and Toxicology, 3rd rev. ed., Vol. 2B. John Wiley and Sons, NY. p. 2879-3816.

Clayton, G.D. and F.E. Clayton, Ed. 1982. Patty's Industrial Hygiene and Toxicology, 3rd rev. ed., Vol. 2C. John Wiley and Sons, NY. p. 3817-5112.

Grayson, M. and D. Eckroth, Ed. 1978-83. Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed. John Wiley and Sons, NY. 23 Volumes.

Hamilton, A. and H.L. Hardy. 1974. Industrial Toxicology, 3rd ed. Publishing Sciences Group, Inc., MA. p. 575.

ITII (International Technical Information Institute). 1982. Toxic and Hazardous Industrial Chemicals Safety Manual for Handling and Disposal with Toxicity and Hazard Data. ITII, Tokyo, Japan. p. 700.

NTP (National Toxicology Program). 1983. Carcinogenesis Testing Program. Chemicals on Standard Protocol. Management Status.

Ouellette, R.P. and J.A. King. 1977. Chemical Week Pesticide Register. McGraw-Hill Book Co., NY.

Sax, I.N. 1979. Dangerous Properties of Industrial Materials, 5th ed. Van Nostrand Reinhold Co., NY.

SRI (Stanford Research Institute). 1983. Directory of Chemical Producers. Menlo Park, CA.

U.S. EPA. 1982. Chemical Activities Status Report, 3rd ed. (EPACASR). Offices of Pesticides and Toxic Substances, Washington, DC. EPA 560/TIIS-82-002b.

U.S. EPA. 1983. Status Report on Rebuttable Presumption Against Registration (RPAR) or Special Review Process. Registration Standards and the Data Call In Programs. Office of Pesticide Programs, Washington, DC.

U.S. EPA. 1983. CHIC Existing Chemical Assessment Tracking System. Name and CAS Number Ordered Indexes. Office of Toxic Substances, Washington, DC.

USITC (United States International Trade Commission). 1983. Synthetic Organic Chemicals. U.S. Production and Sales, 1982. USITC Publ. 1422. Washington, DC.

Verschueren, K. 1983. Handbook of Environmental Data on Organic Chemicals, 2nd ed. Van Nostrand Reinhold Co., NY.